FeyNN Labs AI Product/Service Ideation Task

Project Report 1

Chatbot Recommender System in Restaurant Industry

Submitted By: Sarthak Surolia (Batch 1-22)

Submitted On: February 4, 2022

Table of Contents:

Introduction:

The food service industry is an economic staple generating billions of dollars in annual revenue. Customers have embraced the modern age in all facets of life, but particularly when it comes to ordering goods and services online, such as food. Aiding in this are Artificial Intelligence -powered chatbots, which allows users to place the order from their device with the help of a chatbot. AI integrated chatbots can help business in many ways. With the AI ability extended from text processing to speech, chatbots are no longer just a chat window on a website or a mobile app. AI-powered speech processing systems like IBM's Watson, Apple's Siri, Google's Google Home, VERA and Amazon's Alexa, have changed the applicability of AI concepts from scientific applications to the daily lives of everyday people.

The trend of chatbot service has already started. Industry giants like Pizza Hut, KFC, Dominos, Starbucks, and McDonald's have already adopted AI-driven bots.

Problem Statement:

Suppose you are an entrepreneur and looking to open a restaurant/café/pub, let's say in Delhi. You are new to the Hospitality business and looking for innovative ways to stand out from the crowd. You have to hire staff for attending costumers, book tables for them, hire some agencies for marketing strategies and costumer analytics. We intend to provide an affordable chatbot application customized for those entrepreneurs, which can perform these tasks with minimal human support.

Our focus is on providing customized personal experience while ordering or while reserving tables. It will also collect customer data and provide personalized marketing strategies based on locality or eating preferences of existing and potential new customers. If it is successful in bringing even 10% of the customers to come again, it is much affordable than hiring staff for attending customers or any other above-mentioned task.

Customer-Business-Market Need Assessment:

Before jumping on Market Need Assessment, there is an important question that needs to be answered, that Why this Sector?

The Restaurant industry, bleeding since the pandemic broke out, is at a critical stage. Since last April, it is estimated that more than 300 outlets have shut shop in Delhi alone and 100 each in Noida and Gurugram. These includes standalone eateries and branches of bigger restaurants chains, from fine dining to fast food. Useful insights using AI and Machine Learning are more than ever needed by restaurants managers to cope up with the fast-pacing industry. Despite the increasing interest, the use of AI and robotics in restaurants is still in its early stage and restaurant managers are seeking guidance leverage these technologies for service excellence.

However, the abilities of AI and robots in performing human tasks varies depending on the specific task and the required skills for mastering the activities of this task. The potential of AI technologies should not be assessed by looking at the occupation level. Instead, the activity or task level determines whether human tasks may be replaced by AI and robotics or whether technology should rather enhance human work.

Although Big Food chains have implemented AI on various levels like chatbots for better personalized costumer experience or demand forecasting which can predict the supply of raw materials on an hour basis or service robots or biometrics to track staff movements, etc, still it is out of reach for small restaurants and cafés. So, the market is full of various opportunities which are just there to be grabbed.

External References:

- [Ultimate transformation: How will automation technologies disrupt the travel, tourism and hospitality industries? (degruyter.com)](#)

- [AI in Marketing, Sales and Service: How Marketers without a Data Science ... - Peter Gentsch - Google Books](#)

- [proceedings-configuration-workshop-2018_YslTwntH.pdf (novuscpq.com)](#)
  (Chatbot-based Tourist Recommendations using Model-based Reasoning)

- https://www.researchgate.net/publication/346518362_Application_of_artificial_intelligence_AI_in_food_industry

- [Progress on robotics in hospitality and tourism: a review of the literature | Emerald Insight](#)

- [â•œService Encounter 2.0â•š: An investigation into the roles of technology, employees and customers | Elsevier Enhanced Reader](#)

- https://www.hindawi.com/journals/jfq/2021/4535567/

- https://www.diva-portal.org/smash/get/diva2:1139496/FULLTEXT01.pdf
  (End-to-End Trainable Chatbot for Restaurant Recommendations)

- https://www.youtube.com/watch?v=IV8--Y3evjw
  (Recurrent Neural Networks Architecture by Andrew NG)

- https://web.stanford.edu/class/cs379c/archive/2018/class_messages_listing/content/Artificial_Neural_Network_Technology_Tutorials/KarparthyUNREASONABLY-EFFECTIVE-RNN-15.pdf

- https://www.hurekatek.com/blog/uses-of-chatbots-restaurants

- https://www.commbox.io/restaurant-chatbots-your-customers-will-love-it-plus-8-ways-it-enhances-customer-experience/

- Oriol Vinyals and Quoc V. Le. "A Neural Conversational Model". In: CoRR abs/1506.05869 (2015). URL:
  https://arxiv.org/abs/1506.05869

- https://www.researchgate.net/publication/228712177_Machine_Learning_and_Model_Based_Diagnosis_using_Possible_Conflicts_and_System_Decomposition

- https://uu.diva-portal.org/smash/get/diva2:1365664/FULLTEXT01.pdf
  (Server-Less Rule-Based Chatbot Using Deep Neural Network)

Bench marking Alternate Products:

Across the food service sector, efforts are underway to capture and retain customer interest and business through AI-driven technologies. Chatbots tend to be one of the simpler applications for brands to launch across industries, so it's no surprise that major restaurants are employing these bots to engage customers. Some of the Bench marked products are:

- **Pepper:** Japanese technology firm SoftBank has collaborated with MasterCard to generate an AI-driven humanoid robot called Pepper. Pepper is a robot waiter that processes customer orders, provides product recommendations, and allows customers to make payments via their Mastercard account by using the robot's handheld tablet.

- **Say2eats/Sauce:** say2eats (now sauce) is a New York-based start-up, debuted in 2015 with a goal of helping chains and retailers improve customer engagement through chatbots. The company claims that by texting their favourite restaurants customers can order food through a branded and customized chatbot. Say2eats still functions through Facebook Messenger, Amazon Echo and SMS.

- **Dominoes:** In February 2017, Domino's Pizza claims to have enhanced its Facebook Messenger chatbot, coordinating the release of its new features with the Super Bowl. The AI application named "Dom" allows consumers to begin placing an order by sending a message that only contains the word "Pizza". Updates that were implemented into the system allow customers to order additional menu items such as wings and salads.

There are many start-ups which claims to create an AI driven chatbots which can personalize customer experience. However, the market is still new, and many new restaurants are looking for an affordable chatbot application which can provide customized experience to their customers.

Applicable Constraints:

When creating a chatbot there are several issues and difficulties that need to be addressed.

- To keep track of user intent, i.e., what the user wants. There is a multitude of ways the user can express an intent and the system must understand them all.
- Creating a system that can respond in a consistent way or have a personality is difficult for learning systems. This is because conversational systems are often trained on dialog data collected from many different users.
- This is a technology which will require more fine tuning and improvement before widespread implementation can be expected.
- Application development and integration on a regular basis.
- Convincing the restaurant holders to implement the system in their restaurant.
- Convincing the costumers that the product is genuine. Most people have probably heard of or encountered spambots. Spambots are programs that are designed to automatically send out unsolicited messages through different channels. As chatbots become more advanced they can become difficult to detect and thus more successful at scamming people.

Applicable Regulations:

- Customers' data protection and privacy legislation.
- Employment Laws.
- Government regulations for small businesses.
- Food service license.
- Regulations against false advertising.
- Antitrust Regulations.
- Open source, academic and research community License for educational purposes.

Business Opportunity:

Because the above-mentioned approach has only been employed by major corporations, it may now be used to small enterprises, including not only restaurants and takeaways, but also other potential industries like Tourism industry. Also, chatbots offer 24/7 costumer assistance, a much cheaper alternative to hire 24/7 human support. The ability to have chatbot integration within social media messengers makes bots cost effective for even a small business. It is a one-time investment, rather than hiring a staff or agency. According to a Business Insider report, chatbots can save businesses up to 30 percent more, as compared to traditional customer service solutions.

Product Implementation Method:

1. Abstract:

There are many tasks in which a chatbot can help in restaurants like, Managing Reservations and taking orders, promoting deals and offers, present the menu in a better way, food recommendations, feedback follow ups, etc. However, to keep things simplified we are going to focus only on Managing reservations and taking orders. Now after choosing the task for the chatbot, we face a dilemma. Basically, there are two types of chatbot technology that are currently used, first is the **Task-Oriented Conversation Systems** and other one is **End-to-End Trainable Systems.**

Task-Oriented systems are rule-based system that rely on handcrafted rules that can depend on word or pattern matches, dialog state, entity detection, and so on. The rules specify the action to be taken in each case. These types of models require specific domain knowledge and often massive amounts of manual design to work well. While capable of giving good results in limited domains these models are not usable across domains and have difficulties handling broad domains. Whereas the goal of end-to-end trainable systems is to limit the amount of manual labour needed to create systems that are general, scalable, and capable of operating in broad domains. The End-to-End system uses a RNN Encoder-Decoder Architecture to learn a mapping from the dialog context and responses using the training data.

The End-to-End system can help us achieving the task of providing personalised customer experiences as it is not just a predefined set of

answers, it can be trained to talk like a human. So, we are going to use the End-to-End trainable system for our project.

2.   Data:

We can collect data using real conversations of human to human and it can be custom made for our client or it could be taken from any public data scrapping websites. There are many datasets available online which is cleaned as well as task oriented. The real conversations could contain various noise like spelling errors, wrong information, interpretation errors, etc which makes training even harder. Also, we would need a vocabulary of words using which we can tokenize our training data into format in which our RNN model can interpret its meaning. Additionally, we would also require two knowledge bases for making our API calls, one for real time database of table booking for upcoming week and other of menu preferences. The data can be available on Kaggle or any other open-source platform.

To tokenize the training data either we can use simple methods like one-hot-vectors or advanced methods like word Embedding.

3.   Model:

Two knowledge bases will be used for our managing reservations and taking orders. One database will be a real time database of available tables and bookings for upcoming week and other database will contain the different dishes served by the restaurants, their ingredients, their origin region, veg or non-veg, their price range, their costumer rating, etc. This database can be a customised according to our client's need. The user does not have to know all the information about the food he wants, rather it's the task of the bot to help user find a good option based on specified preferences. To achieve its goal the chatbot has to be able to process and interpret natural language input. Based on this input the bot has to perform actions such as asking for more information to clarify a user request, query a knowledge base to retrieve information, interpret the results of queries, and display the results in a suitable way to the user. If the user changes their mind, the bot should be able to recognize this and strive to achieve the new goal instead. We will use API calls to our knowledge base for retrieving the required options. There are basically 5 tasks which our chatbot must perform.

Task-1 issuing API calls: The bot has to issue API calls on the basis of interaction with user. The API call query can have various required fields like price, cuisine, veg/non-veg, any specification related to ingredients like gluten free or vegan, etc. The user can implicitly state between zero to n no. of queries and system has to learn to ask for remaining preferences.

Task-2 updating API calls: Sometimes it may happen that user want to change its preference like price range or cuisine or booking date, etc. Then it's important that bot updates the preference and then give options according to it.

Task-3 conduct full length dialogues: To provide a more personalised customer experience it is necessary that our bot conducts full length conversations with customers. It is the very reason we won't use task-oriented conversation system.

Task-4 provide extra information: Suppose a person makes a reservation and asks for additional information like its ingredients, beverages that goes with it, customer review, etc.

Task-5 displaying options: After the chatbot runs an API call according to user preference, a list of options may come. Then our chatbot must display top options for the user to choose.

However, there are two major issues with this kind of recommender system chatbots, first is that in case of too little preference details there can be many options in front of chatbot and randomly choosing an option is not a good idea. Second issue is that in case of too many preferences chatbot may not find even a single preference.

One thing bot could choose is to ask for more important preference in case of two contradicting preference or more preferences in case of less preferences. But how to restrict the search space in an optimal way?

This problem was addressed in a paper published in 20'th International Configuration Workshop. Using an Entropy based model we can find the entropies of various preferences and choose the preference with highest entropy to further restrict the search space.

4.   Chat Program:
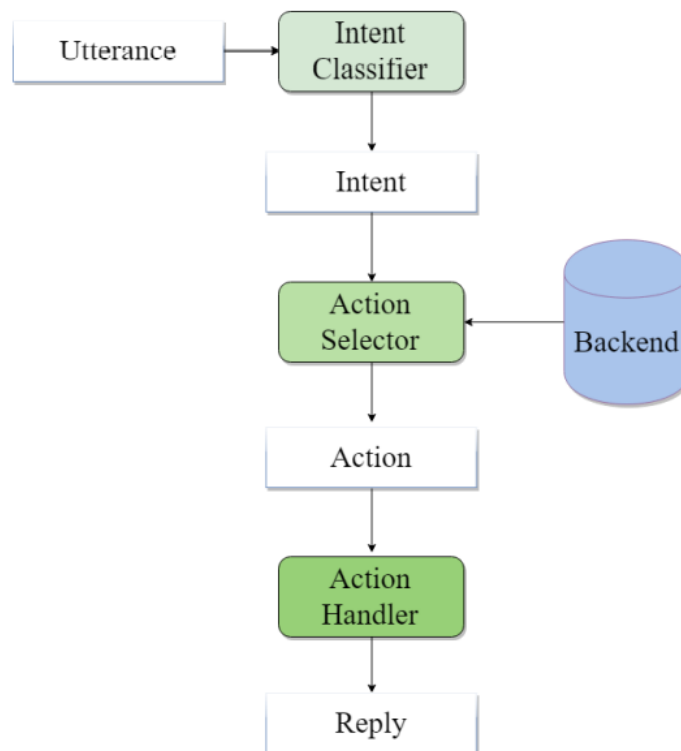
Basic Chatbot Architecture

This is the basic Chatbot Architecture which defines the steps it takes in generating the response for a costumer.

- Given an utterance, first it tokenizes the statement using techniques like Embedding, Stemming, Lemmatizations, etc.
- Then we must identify the intent of user. For e.g., he may want to reserve a table in the restaurant, or he may want to order the food, or he may want to ask a query. The bot should clearly understand what user wants. It is a multi-classification problem and done using Intent Classifier.
- Based on the intent of user next step is carried out. If the intent of user requires to raise an API call, bot uses a slot filling Algorithm, if the intent is not certain, bot uses a generative based Algorithm to respond.
- After identifying the intent of user, bot matches he preference of user to the required fields to raise a query. If preferences are sufficient, then bot issues an API call for it. In case of insufficient information, bot may ask user for some additional details. These all conversations are rule-based, and bot responds with the best probable answer in its training set.

- After going through the options bot chooses the best among it and show it to user for confirmation.
- The conversation of bot is carried out using Sequence to sequence RNN model. There are several models within a single cell of RNN that we can use. However, it is observed that bidirectional LSTM/GRU work with much greater efficiency.

Conclusion:

Chatbot application is still an untapped field with a lot of potential in almost every sector. From a simple application performing one or two task to a complex one handling many tasks simultaneously, chatbots can be moulded according to client's need. It replaces hours of tedious human work and can also provide a 24/7 assistance. With the correct approach it can magically enhance the overall costumer experience. The restaurants in India depends on local marketing strategies which cost them a fortune and still it is not a surety that they work. Chatbots are comparatively less expensive and prove to be more effective. Although we cannot create chatbots with the accuracy level of big giants like IBM Watson, or Dominoes, etc, still a decent working chatbot handling one or two tasks with great accuracy can be created.